REMARKS/ARGUMENTS

The Examiner rejects claims 47-53, 55, and 59-60 under 35 U.S.C.§102(b) as being unpatentable in view of Yonehara (U.S. 005453394A); claims 54 and 56 under 35 U.S.C.§103(a) as being unpatentable over Yonehara in view of Doyle (U.S. 006054370A); claim 57 under 35 U.S.C.§103(a) as being unpatentable over Yonehara in view of Yamagata (U.S. 005250460A); and claim 58 under 35 U.S.C.§103(a) as being unpatentable over Yonehara in view of Harris (U.S. 005798293).

We disagree with the Examiner's rejections for the reasons set forth below. The prior art fails to teach or suggest at least the italicized features of independent claims 47 and 62:

> 47. A method of making a hybrid substrate assembly comprising:
> implanting a preferential etching layer *within* a wafer to thereby form a membrane on a surface of the wafer, *the preferential etching layer being located interiorly of at least first and second opposing surfaces of the wafer and the membrane being located between the preferential etching layer and the first surface of the wafer, having a different chemical composition than the preferential etching layer, and being more resistant to etching by a selected etchant than the preferential etching layer*;
> permanently attaching a substrate-of-choice to the membrane; and
> etching the preferential etching layer with the selected etchant *to separate the membrane from a remainder of the wafer and thereby provide a hybrid substrate assembly that includes the substrate-of-choice permanently attached to the membrane*, wherein the wafer is less susceptible to the etchant than the preferential etching layer.

The present invention is directed generally to implanting selected elements within a wafer to alter the chemical composition of the implanted area and thereby change the susceptibility of the implanted area to etching. When oxygen is the implanted material, this type of targeted implantation within a wafer or substrate is known as SIMOX or Separation by ion IMmplanted Oxygen.

Yonehara et al.

Yonehara et al. is directed to a process for preparing a semiconductor substrate. The method is generally directed to bringing a first substrate provided with boron and/or phosphorus on the surface of an insulating layer formed on the surface of the substrate in contact with a

second substrate and heating the two substrates, thereby integrating them together. According to Yonehara et al., the method includes:

> a step of making an entire silicon monocrystalline substrate as a first substrate porous by anodization, a step of making a silicon substrate monocrystalline substrate thin film to epitaxially grow on one of the porous surfaces, a step of oxidizing the surface of the silicon monocrystalline thin film, a step of forming an insulating layer capable of softening by heat treatment on the oxidized surface, a step of making the insulating layer of the first substrate to tightly adhere to a second substrate, and a step of heat treating the first substrate and the second substrate tightly adhered to each other and then selectively etching the porous regions.

(Col. 4, lines 51-61.) At col. 7, lines 62-64, it is stated that "[t]he region to be made porous can be *only* a surface layer on one side of the substrate or can be *extended to* the entire substrate." (Emphasis supplied.)

Ion implantation is *not* performed within the substrate to form an oxide layer beneath the surface of the first substrate. Regarding the use of the SIMOX (Separation by ion IMmplanted Oxygen), Yonehara et al. states that "the implantation time is very long and the productivity is not so high" resulting in "a high wafer cost" "Furthermore, there remain many crystal defects. That is, no commercially satisfactory quality for making minority carrier devices is obtained." (Col. 2, lines 44-48.) Yonehara et al. therefore *teaches away* from implanting materials within a targeted area located inside of a wafer, such as SIMOX.

<u>Doyle</u>

Doyle is directed to a method of fabricating a film of active devices using ion implantation within a substrate (contrary to the teachings of Yonehara et al.). First damaged regions are formed preferably by helium implantation in a substrate underneath first areas of the substrate where active devices are to be formed. Active devices are formed onto the first areas. Second damaged regions are formed preferably by hydrogen implantation, in the substrate, between the first damaged regions. The implanted regions are annealed to further stress the

implantation regions and detachment of the film from the rest of the substrate at a location where the first and second damaged regions are formed. As Doyle too uses a stressed layer to effect separation, Doyle teaches away from the use of etchants.

<u>Yamagata et al.</u>

Yamagata et al. is directed to a method of producing a semiconductor substrate that includes forming pores in the entire body of a single-crystal silicon substrate by anodization, epitaxially growing a single-crystal silicon layer on a surface of the porous single-crystal silicon substrate, sticking a supporting substrate to the surface of the epitaxial layer of single-crystal silicon by using an adhesive, selectively etching the porous single-crystal silicon substrate, sticking the epitaxial layer fast to a transparent insulating substrate containing silicon dioxide as a main constituent, separating the supporting layer from the epitaxial layer by removing the adhesive, and heat-treating the epitaxial layer stuck fast on the transparent insulating layer. Alternatively, a porous layer is formed in a surface portion of a single-crystal silicon substrate and then the non-porous portion is removed before the porous layer is selectively etched.

Yamagata et al. too teach away from SIMOX. At col. 2, lines 44-54, it is stated:

> SIMOX is well matched with the silicon process and regarded as the most satisfactorily developed technique in method (2). However, 10^{18} oxygen ions or more per square centimeter must be injected in order to form an SiO_2 layer. Such oxygen injection requires a long time, resulting in low productivity and increasing the cost of the wafers. Moreover, a substantial number of lattice defects are still produced in the products, and therefore, the products are not good enough to be used to produce minority-carrier devices on an industrial scale.

At col. 5, lines 20-23, it is further stated:

> Further, this method can replace the costly SOS and SIMOX methods to produce semiconductor substrates which are suitable for large-scale integrated circuits having SOI structures.

Harris

Harris is directed to a method for producing a semiconductor layer 8 of SiC of the 3C-polytype on top of a semi-conductor substrate layer 6 using wafer bonding techniques. Two amorphous layers are placed face-to-face and bonded by heating them. The piece so obtained is annealed at such a high temperature that the material of the amorphous layers is allowed to flow for relaxing a 3C-SiC layer 4 on top thereof. A second layer 8 of 3C-SiC is after that epitaxially regrown on top of the relaxed 3C-SiC layer.

Accordingly, the pending claims are allowable.

The remaining dependent claims provide further reasons for allowance.

By way of example, Claim 53 and 56 are directed to thermal oxidation of an implanted area before etching and removal of the donor substrate. Doyle teaches away from thermal oxidation of the oxide layer. First, Doyle does not teach thermal oxidation of the oxide layer prior to cleavage. Second, Doyle fails to state that the annealing step occurs in an oxygen-containing atmosphere. Third, Doyle, by teaching the use of a stressed layer for detachment of the film from the rest of the substrate, teaches away from thermal oxidation. Thermal oxidation grows the oxide layer and reduces the stress internal to the layer. Thermal oxidation therefore will de-stress the layer of Doyle, thereby complicating or altogether rendering inoperative the cleavage step of Doyle. The oxidation temperature is greater than the temperature of the implanting step and at least about 600°C. Such pre-cleavage heating temperatures are contrary to the teachings of Doyle. At col. 4, lines 17-20, Doyle teaches that annealing of the hydrogen implanted regions does not exceed 400°C, apparently to avoid loss of the hydrogen gas.

Dependent Claim 57 is directed to the reuse of the wafer or donor substrate. The Examiner relies on Yamagata et al. for the proposition that the reuse is obvious. This reliance is misplaced. Yamagata et al. in fact teaches away from the reuse of the donor substrate. Rather, Yamagata et al. teaches, at col. 7, lines 23-25, that the supporting substrate 110 is reused not the single-crystal silicon substrate 100 (or donor substrate). As shown by Figs. 1A to 1E, the substrate 100 is removed (destroyed) by etching and/or grinding. (Col. 7, lines 26-31.)

Based upon the foregoing, Applicants believe that all pending claims are in condition for allowance and such disposition is respectfully requested. In the event that a telephone conversation would further prosecution and/or expedite allowance, the Examiner is invited to contact the undersigned.

Respectfully submitted,

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